The Raw Materials Transition in the Amsterdam **Metropolitan Area:**

Added Value for the Economy, Well-Being, and the Environment

by Jacqueline Cramer

Growing organic materials (such as hemp, elephant grass, bamboo, and flax) or harvesting roadside grass or aquatic plants can produce





The AEB (Waste-to-Energy Company) is moving in the direction of a circular economy by focusing on several activities, including providing district heating, sorting of electronic and electric equipment, and recycling of diapers.

he Amsterdam Metropolitan Area aims to become a circular hub of products and raw materials. This will strengthen the area economically, create jobs, stimulate innovation and improve the environment. To realise this ambition, the private sector and public sector, knowledge institutes, and residents are working together in innovative ways, applying new business models tailored to this challenge.

A raw materials transition is urgently needed because of the shortage of raw materials worldwide and Europe's strong dependency on their import (90% import from non-European Union countries). The commitment to sustainability has, moreover, become a sheer necessity, and public pressure to act accordingly is growing. By finding smart ways of coping with the excessive consumption of resources, the Amsterdam Metropolitan Area aims to achieve major financial-economic, social, and environmental benefits. This endeavor dovetails perfectly with the philosophy of the circular economy and the

specifics of the Amsterdam Metropolitan Area. It has more than 2.3 million inhabitants, a wide variety of industrial sectors, an energetic startup community and citizen involvement, and an environmentally conscious political culture.

The concept of a circular economy refers to "an economic system based on the reuse of products and raw materials and the restorative capacity of natural resources. It also attempts to minimize value destruction in the overall system and to maximize value creation in each link in the system. The goal is to counteract the depletion of natural resources, phase out waste, greenhouse gas emissions and the use of hazardous substance; and make a complete transition to renewable and sustainable energy supplies."¹

Within the broad theme of the circular economy, the Amsterdam Economic Board has established two main programs: the "energy transition" program and the "raw materials transition" program. The energy transition program seeks to accelerate the transition to a sustainable energy supply. The emphasis is on initiatives that can only be developed through regional collaboration. Examples are the extension of the heating grid, the reuse of CO_2 in greenhouse horticulture and industry, and stimulating sustainable mobility and zero energy construction in the housing sector. The raw materials transition program aims to keep material flows and products in circulation as effectively as possible to avoid the waste of raw materials. This means reducing raw materials use, reusing products, and the high-grade recycling of material flows. The raw materials transition program is detailed next.

The Raw Materials Transition: Where Do We Stand Now?

The raw materials transition is not an entirely new endeavor. Systems to reuse products and materials are already in place, but most of the applications are low-grade. We can do things differently and more effectively. By concentrating on a more extensive reuse of products and a more effective recycling of material flows, we can create more industry,

more jobs, more innovation, and greater environmental benefits. In the Netherlands this is tentatively predicted to lead to 54,000 to 83,000 added jobs,12 25% less import of raw materials per year, and a CO₂ reduction of 17 megaton-equivalents per year (which is 10% of our yearly CO₂ production).¹ By systematically researching ways of advancing up the circularity ladder (see Figure 1), we can prevent waste and create potential value. Estimates show that this raw materials transition represents a net material cost saving opportunity of around 7.3 billion euros per year in the Netherlands, and USD340 to 380 billion per year for a transition scenario and USD520 to 630 billion for an advanced scenario at the European Union level (calculated for just part of the industry).^{1,3}

Think Global, Act Local

Cities and regions have a crucial role to play in achieving the raw materials transition. This is where policy formulated at the national, European, and even international levels is implemented. What is already being done with regard to the reuse and redesigning of products and the recycling of raw material flows? And which areas require additional effort to accelerate the raw materials transition?

Reuse and Redesign of Products

Initiatives regarding the reuse and redesign of products mainly gain traction at the level of companies, neighborhoods, and municipalities. Until recently, the number of initiatives was fairly limited, but it is now growing steadily. This is demonstrated by all sorts of initiatives in city neighborhoods, by startups and existing, proactive companies. Examples are the Circular Buiksloterham location for startups in Amsterdam, the Instock Restaurant in Amsterdam that converts rejected but good food into meals, the Peerby app to facilitate the sharing of tools instead of buying everything, a lamp made of discarded bottles, the Cradle to Cradle

Figure 1. Levels of Circularity: 10 R's

Levels of circularity: 10 R's



carpet of Interface, and so on. The possibilities for reusing, repairing, and reviving products are far from exhausted and can create all sorts of new enterprises at a local level. Estimates of the potential number of new jobs vary, but quickly run to 2000 extra jobs in the Amsterdam Metropolitan Area by 2025.4 If this is combined with a shift from the sale of products to hiring or leasing them, this number can increase even further. In this scenario, a business or organization (e.g., the Schiphol airport) no longer buys LED lamps but lumens for a certain price. The lumen vendor remains the owner of the lamps and thus remains responsible for recycling of the lamps after use. Finally, redesigning products with a view to circularity can also lead to new business and innovation, and hence to more jobs. One example could be to design clothing with a 3D printer and using recycled materials, or to manufacture products on a renewable, organic basis. Growing organic materials (such as hemp, elephant grass, bamboo, and flax) or harvesting roadside grass or aquatic plants can produce a flow of organic materials with which to make clothing, ingredients for paint and paper, and so on (e.g., the paint producer RIGO, the paper producer Millvision, and sustainable clothing developer KURT's Amsterdam).

All forms of product reuse and redesign mentioned here potentially form a huge economic motor in a circular economy. Precisely in these areas, startups can set to work with innovative ideas and forms of collaboration and financing. The repair and maintenance companies will also have a more prominent role, as will the traditional environmental depot systems for bulky domestic waste. They can be converted into circularity stations, surrounded by various forms of business activities, for example, companies that refurbish furniture or build new furniture using discarded wood. Almere is the first city in the Amsterdam Metropolitan Area that is already setting up a circularity station. Municipal authorities can give such trends in the field of product reuse and redesign an extra impetus-for instance, by creating physical space for such initiatives, by establishing innovation funds, and by making the acquisition of circular products a part of their own procurement policy.

Collaboration within the Amsterdam Metropolitan Area in these areas will save everyone from having to reinvent the wheel. By exchanging knowledge and experience, municipalities can learn from each other and adopt each other's best practices. To support the municipalities in this effort, the Amsterdam Economic Board recently set up a learning community that focuses on circular procurement. Furthermore, it offers assistance in the exchange of knowledge regarding product reuse and redesign and provides a platform for startups to offer circular products and services on the market.

Recycling Material Flows

Municipalities also have an important role to play in recycling material flows. They collect domestic waste and can influence how this waste is processed through their procurement policies. Municipalities also monitor compliance with rules regarding the collection of industrial waste. Much domestic and industrial waste is still incinerated, but this amount will decrease in favor of increasing recycling. This is in line with the increasingly stringent Dutch and European Union policies with regard to waste management as part of a shift in EU policy towards a circular economy.5 An additional factor is that the technical capacities for recycling have improved considerably, especially in terms of highgrade recycling. Numerous opportunities exist, but these will not necessarily all be utilized, because many initiatives in this field can only be realized if municipal authorities are willing to work together. After all, recycling often requires substantial investments in advanced recycling plants, depending on types of material flow. The private sector is certainly interested in these options, but businesses need to have sufficient assurances regarding the volume of collected material they can expect and the sales potential of the recycled material. If such certainty cannot be offered, then the collected material flows are processed and marketed in the form of low-grade applications. Consider, for example, fruit, vegetable, and garden waste: This material is now incinerated to generate power. In the municipality of Amsterdam, 97% is processed this way or at best converted into compost. Both are low-grade applications. When there is investment in bio refineries, high-grade products for the chemical and pharmaceutical industries, such as proteins and bio-based aromatics, can be produced.



Instock Restaurant and Catering turns food waste into delicious food.

This has been tested successfully in the laboratory; now is the moment to scale up the process.

The number of material flows in the Amsterdam Metropolitan Region that are currently incinerated or processed in low-grade ways is high-especially when considering both domestic and industrial waste. It is important, therefore, to set priorities in the approach to waste. An obvious place to start is the huge flows of domestic waste that are currently mainly being incinerated or low-grade recycled; those flows have great potential for high-grade processing. Thus, the Amsterdam Economic Board and the municipalities in the Amsterdam Metropolitan Area decided in 2015 to focus on the nine following material flows:

- 1. Construction and demolition materials: making the construction and demolition of buildings a circular process.
- 2. End-of-life textiles: sorting according to material, fiberizing and spinning new yarn.
- 3. Plastics: sorting and recycling/reselling each type of plastic.
- 4. Biomass: high-grade recycling of specific biomass flows such as fruit/vegetable/garden waste, sewage sludge, agro-food chain waste, and public greenery (including aquatic plants).
- Electronic and electrical waste: disassembling discarded appliances and recycling/reselling reclaimed materials.
- 6. Incontinence products and diapers: high-grade recycling.
- 7. Mattresses: high-grade recycling.
- 8. IT (information technology) sector servers: reuse as product and high-grade recycling.
- 9. Metals: starting with niche markets for high-grade recycling of specific material flows.

Separate strategies have been prepared for each of these materials flows in a collaboration of the private sector, experts, and public authorities, setting out the conditions required to make a transition to high-grade recycling profitable. These conditions can include assurances in terms of volume and market opportunities, relevant research, collaboration between businesses with the same type of waste flow, and/or the introduction of a different revenue model. The objective is to have for each of the nine material flows a consortium of partners in place before 2018 that is committed to implementing high-grade recycling within a few years. For that purpose the Amsterdam Economic Board and regional municipalities have started to make "circular commitments" for specific material flows with the private sector. Once an initiative is up and running, the board will, in principle, leave the operation to the parties that agreed to the circular commitment. The board can then turn its attention to new material flows that can be recycled to produce higher grade products.

Approach per Material Flow

The approach varies for different material flows, as does the division of roles between the private and public parties. Approach and division of roles are determined in advance for each circular commitment. Roughly, we distinguish the following three categories.⁶

1. Materials that can be reintroduced into the cycle at a municipal level. A good example here concerns the construction chain. In the municipality of Amsterdam, this material flow constitutes 40% of the total waste flow. Demolished materials are currently recycled, but 90% of it is turned into low-grade applications such as making road foundations. Tentative estimates show that making the entire construction chain (building and demolition) in the Amsterdam Metropolitan Area circular can lead to added value. It can potentially increase value creation by 85 million euros per year and generate about 700 added jobs, mainly in the low and intermediate skills sectors. Moreover, it can lead to a significant resource efficiency of 500,000 tons and a CO₂ reduction of about 0.5 million tons per year.7 The main drivers to accomplish

these objectives are strict procurement policies regarding circular demolition and construction in the building sector, introduction of smart design principles, and the creation of physical storage areas and a marketplace (including an electronic database) to exchange information about available circular resources. Making the construction chain circular is mainly a local operation, but it does require coordination at the (sub) regional scale, for instance, for temporary physical storage of demolished materials and setting up an electronic database. Several municipalities in the Amsterdam Metropolitan Region have joined forces in a "Circle City" deal to implement the circularity principles in their procurement policies regarding demolition and construction. An example is the circular demolition and construction of 470 houses in western Amsterdam, where 95% of the resources were reused.

Electronic and electrical waste is another example. Discarded products can be disassembled at the subregional scale, while the recycling of reclaimed materials requires a regional or even higher level organization. Establishing local centers for disassembly will create more job opportunities at the subregional level, including for people with poor job prospects. While these additional jobs will partly replace jobs at the current centralized disassembly centers elsewhere in the country, the recycling of reclaimed materials will produce more employment opportunity and achieve greater environmental benefits. The first step in this process is made in the region by setting up two local centers, while the next step, recycling, is now being prepared.

The division of roles between public and private parties must be tailored per material flow. As an example, to make the construction chain entirely circular, the commissioning clients (government and private sector) play a crucial role by making circularity a key principle of their procurement policy. It is then up to the market to build and demolish in a circular manner. However, supplying temporary storage facilities



Waternet reclaims various substances from its sewage sludge (phosphates, nitrates).

for demolished materials again requires the involvement of a public authority.

2. Materials that must be bundled at a regional level to create sufficient volume and sales potential for a profitable business case. This applies, for example, to the high-grade processing of fruit/ vegetable/garden waste, end-of-life textiles, unsorted domestic plastic waste, and incontinence products and diapers. Public authorities are required to ensure sufficient quantities of input material through their procurement policies; subsequently, it is up to the market to invest in high-grade recycling plants.

Here again, the division of roles between government and the private sector must be tailored to requirements. Consider, for example, the large volume of organic residual flows that are fit for high-grade recycling. The approach needs to differentiate between domestic fruit/vegetable/garden waste, residual

flows from the agro-food chain, sewage sludge, and public greenery (including water plants). If public and private parties can coordinate their roles effectively, the high-grade recycling of all these biowaste flows is very valuable. Based on tentative estimates, this approach can generate in the Amsterdam Metropolitan Area about 150 million euros of added value per year and 1200 new jobs (and indirectly, even more jobs can be created in the supplying industries). Moreover, it can potentially lead to a resource efficiency of about 900 thousand tons and a CO₂ reduction of 600 thousand tons per year.7 To realize these objectives requires a number of incentives, such as separation at source of biowaste streams, the creation of a hub for one or more biorefineries, the development of a virtual platform for bioresources, and circular procurement policies to promote the use of recycled biomaterials by launching customers.

Here too, initiatives have already been taken in the Amsterdam Metropolitan Area to generate higher yields from biowaste streams. For example, the water company Waternet reclaims various substances from its sewage sludge (phosphates, nitrates), experiments with further biorefinery, and runs a pilot calcite factory. Another example is the investment being prepared in a plant for the recycling of public greenery into products for the paper- and chemical industry.

3. Material flows that are too small for the individual company but are viable for high-grade recycling when combined from multiple companies, including a proper revenue model for the participating companies. Such instances are found in the agro-food sector. One example is bleaching earth, a by-product of food production. Working with several companies to pool bleaching earth and developing an organizational and financing model adapted to requirements can lead to profitable high-grade recycling of this material. Since the individual companies consider bleaching earth to be waste, it is not obvious for them to pursue collaboration. There are more such examples of residual flows within the agro-food sector that are not recycled but are mainly incinerated for the same reason. By joining forces and setting up a recycling plant, companies can create added value and new jobs. This idea has been taken by the company Exter, specializing in savory tastes, the Green Campus Amsterdam, and the Technical University Delft. They have recently signed a commitment to develop a multipurpose biorefinery in Zaanstad, based on a cooperative business model in which suppliers of biowaste streams participate.

Building up a range of new activities geared to high-grade recycling of material flows implies a gradual decrease in the capacity of waste processing plants. After all, the remaining waste flows will decrease steadily. The destruction of capital can be avoided by carefully coordinating the processes of building up the circular economy and reducing the existing incineration capacity at a regional level. Imbalances can be remedied provisionally in the Netherlands by importing waste from other European countries such as the United Kingdom. Overall, the transition process to high-grade recycling will lead to more industry and jobs, more innovation and knowledge development, and greater environmental benefits. Most initiatives in the field of high-grade recycling require considerable investments in new recycling plants, which

will mainly attract large investors. There are also opportunities for startups, however, especially in terms of contributing innovative ideas and responding to the business opportunities presented by high-grade recycling, for example, by using the PET recycling flow for 3D printing.

Regional Collaboration: A Condition for Success

Municipalities, in collaboration with businesses and citizens, have already taken significant steps in making the raw materials transition. Nevertheless, their efforts can be amplified through collaboration throughout the Amsterdam Metropolitan Area, which will benefit all parts of the region. Each subregion within the area has its own economic





Circular demolition and construction of 470 houses in western Amsterdam where 95% of the resources were reused.

strengths that connect to specific components of the overall transition program. Each subregion can therefore choose its own positioning based on economic strength and specific educational, cultural, and societal priorities. After internal coordination among the subregions, the clusters of circular industry that each subregion will primarily concentrate its efforts on has recently been determined. For instance, the Westelijk Havengebied (western harbor area) is exceptionally well suited to large-scale industrial activities, the Zaanstreek (north of Amsterdam) to high-grade recycling of agro-food flows, Haarlemmermeer (close to the Schiphol airport) to the cultivation of organic materials and circular construction and demolition, and Almere/Lelystad (west of Amsterdam) to the recycling of aquatic plants.

By joining forces within municipalities and at the regional level with the private sector, knowledge institutes, and residents, the Amsterdam Metropolitan Area's objective is to evolve into a main circular hub in Europe for products and materials. The raw materials transition can create a cultural and economic climate that appeals to creativity and will for renewal. Also, it produces added value for citizens and businesses in the fields of the economy, well-being, and the environment.

NOTES

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